THE ROLE OF SCIENCE IN EFFICIENT BEEF CATTLE PRODUCTION AND PROGRAMMING PROCEDURE AND PRACTICE FOR PRODUCERS IN UGANDA

by 544

EMMANUEL FRANCIS BAJUNIRWE

B. Sc. (Dunelm) Durham University, Great Britain, 1964

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

Approved by:

Don L. Good

Major Professor

TABLE OF CONTENTS

TABLE OF CONTENTS—Continued

I. GENERAL BACKGROUND

Geography:

Situated astride the Equator, Uganda is an entirely inland territory, and its main town, Kampala, is 874 miles by rail from the coast. The neighboring countries are the Sudan, Kenya, Tanzania, Ruanda and the Congo. With an area of 93,981 square miles including 5,670 of swamps and 13,689 of open water, Uganda is comparable in size with Great Britain.

Uganda enjoys an equable climate with little variation in temperature. Kampala exemplifies the climatic conditions of the Lake Victoria Zone. Its average rainfall of 70 inches is reasonably distributed throughout the year, and its mean maximum temperature is 75° F while the diurnal variation may be about 25° F.

In the interior of Uganda, however, a dry zone stretches discontinously across the country from the southwest to northeast. This region receives an average of 35 inches of rainfall on an average total of 127 days in a year; and has a marked dry season in May through to the end of August. It is mainly during these dry months that the greatest losses in vigor, thriftness and overall beef cattle health occur. This region's average temperature is 70° F with a daily variation of 20 to 25° according to season. Under these conditions short grasses occur either as pure formation or as open woodland to give a tropical savannah grassland belt.

Population and economic activities:

It is noteworthy to mention population and economic activities, as both of these factors in some way or another influence the nation's scientific endeavor in improvement of beef cattle industry.

Uganda has a population of 7 million (Uganda Report 1965). Africans comprise over 98% of the population, and within the small non-African element the ratio of Asians to Europeans is about seven to one. Nearly all Asians live in towns and are engaged in textile trades of one kind or another. Over 80% of Africans live on the land. The average density of African population per square mile of land is 85 but district averages vary from 300 in the southwest corner to 10 in the northeastern corner.

Uganda's economy is largely agricultural. Millets are the traditional staple food for short grass areas, whereas plantain flourish in the higher grass zone around Lake Victoria; and cassava, sweet potatoes, beans, ground nuts, (peanuts), maize, and soybean are widely used as supplementary subsistance crops. The main cash crops are coffee, cotton, tea, tobacco, cocoa and are grown entirely by African farmers.

Mineral resources and manufacturing industry have not, in the past, played a very significant role in total economy of Uganda. However, there is a large-scale production of cement and phosphatic fertilizer and an appreciable amount of copper is produced for export.

Devotion to pastoral activities is strongest in the short grass zones. These short grass areas are the Flint Hills of Uganda; and 90% of the nation's 3.6 million cattle are found in this area (Uganda Vet. Sci. Ann. Rept. 1966).

II. A CASE FOR BEEF CATTLE IN UGANDA'S AGRICULTURAL FRAMEWORK

By reason of its geographical situation and its limited mineral resources, Uganda's economic development must be in the fields of agriculture and livestock. The underdeveloped potential in the cattle industry becomes increasingly important because of the very rapid natural growth of population and improvement in the standard of living.

Table 1. LIVESTOCK CENSUS: 1965

	Cattle	Sheep	Goats	Pigs	Donkeys	Camels
1965	3,626,643	790,933	1,997,713	37,280	16,651	1,000
1964	3,496,797	754,833	2,013,597	18,738	16,206	408
1963	3,463,937	861,362	1,990,915	18,738	16,206	408
1962	3,464,603	760,016	2,339,920	14,751	--	--
1961	3,382,762	839,219	2,532,953	16,069	--	--
1960	3,618,180	865,000	2,592,000	15,594	--	--
1959	3,590,335	959,324	2,764,635	15,668	--	--
1955	3,094,362	1,093,247	2,513,732	12,376	--	--
1950	2,533,819	1,065,822	2,324,232	17,366	--	--
1945	2,293,740	995,321	2,143,533	23,158	--	--
1935	2,197,536	1,062,139	2,335,033	--	--	--

The livestock census of 1965 (Uganda Vet. Sci. Ann. Rept. 1966) clearly shows that there are more cattle than any other livestock. However, numbers in themselves have little relevance, other than a starting material, if the cattle are

unproductive and uneconomic to the producer. In fact Uganda imported the equivalent of 12,300 head of cattle, and more than 6,000 gallons of milk per day, from Kenya in 1963, (Stobbs 1965). While the internal demand for good quality beef is steadly rising, export markets could greatly be improved. The main setback in Uganda's export trade has been diseases, such as pleuro-pneumonia, riderpest and foot and mouth disease, and of course relatively poor quality products.

Cattle are an integral part of the farming system in the arable cropping areas and can be utilised for soil fertility in addition to yielding an economic return to the farmer, particularly in areas which are marginal for crop production. For climatic and population density reasons the general trend has been for the dairy industry to develop in areas skirting Lake Victoria. The savannah belt with less distributed rainfall and lower population density is more suitable for beef cattle production. Beef cattle ranching will be economically viable in this area if more capital and competent personnel can be injected in the undertaking. The vast majority of Uganda is arable country where the price of beef is about 25¢ per pound, and it is with this more difficult area that Uganda beef cattle research is concerned.

One of the factors which have called attention to beef cattle production in this area is the improvement in soil fertility. Soil fertility is a problem of grave concern to developing Uganda. As far as can be judged (Uganda Rep. 1965)

the population will double within 30 - 40 years. The traditional system of shifting cultivation cannot be expected to cope with this enormous increase in human numbers. Another factor increasing the pressure on the land has been the grafting of acash economy onto the old traditional system of subsistence agriculture. This has meant that land that might have been available for the growing of food crops is now used for the production of a cash income. Therefore, research is urgently needed to develop a settled system of agriculture where a farmer can take a piece of land and keep it in good heart, not only for himself but for those after him. In fact the aim should be to develop a farming system whereby the yields from a plot of land are not only maintained but increased to allow for the increasing population attainment of a rising standard of living every human has a right to expect. One method of achieving this would be by large scale use of artificial fertilizers, but unfortunately use of these fertilizers is, at the moment, uneconomical because of lack of land consolidation in most areas. The onus is, therefore, put onto cattle which have been found to assist in maintenance of soil fertility under the present systems of cattle management.

Circulation of existing Soil Nutrients:

This is largely a counteraction of the natural effects of leaching, where nutrients are washed into the subsoil beyond the reach of shallow-rooted annual crops.

These nutrients together with those produced by the weathering of the more accessible soil parent material can be obtained by the relatively deep-rooted perenial grasses and brought to the surface. If this grass is not being grazed, the valuable nutrients are locked up within the plant tissue and do not readily become available to the soil until it is plowed (Stobbs 1965). On the other hand, where beef cattle are present, these plant materials are eaten, and excreted back on the soil in a more readily available form. This defoliation then stimulates the plant to bring up more nutrients which are then laid on the surface by the animal. The value of grazing was demonstrated on three-acre blocks at Ngetta Experimental Farm where the yield of all crops on grazed plots outyielded adjacent ungrazed plots (Stobbs and Joblin 1966). There is need for further investigation to understand more fully the mechanism involved. The demonstration of quite substantial beneficial effects from day grazing is particularly gratifying as this can be considered as an essentially subtractive treatment. That is, although animal defecation rates are essentially the same by day and by night, the proportion of day grazing is relatively high--of order of 70-80 percent (Harker et al. 1954). The net result is the removal of nutrients from the plot and it would be quite logical to expect a decline in soil fertility resulting from this type of grazing. The fact that an improvement in fertility was demonstrated, is a strong indication of the value of the grazing animal in the maintenance of soil fertility.

Night grazing:

In rural areas fencing land has not caught up yet. Cattle are still being grazed on common land during the day and brought in the Kraals for the night. A more direct way to build up soil fertility using the grazing animal would be to graze the land intended for cropping by night and to obtain day grazing from swamp margins and other non-arable land. Whereas fencing grazing land is still largely outside the financial ability of most farmers, fencing small crop land as night paddocks is within their capabilities. In this way fertility can be transported from the places it is not economical to places where it can be utilised. A 20 acre trial at Serere Experimental Station demonstrated a significant increase of 100 lb. of seed cotton on plots that had been night paddocked at a rateof two beasts per acre as compared with ungrazed plots (Stobbs 1965).

For the farmer who makes a practice of growing a variety of crops and who divides his time between crop production and animal production, beef cattle possess a number of advantages over other kinds of livestock.

Beef cattle utilize large quantities of roughage. Roughages can be harvested at time of plenty and be conserved for cattle feeding during the drought months or when required. As methods of agricultural production improve and mechanised farming gradually takes over hand-hoe farming, beef cattle will be a useful economic outlet for the unsalable roughages

such as corn stover, and millet straw. Beef cattle offer efficient utilization of these roughages which are usually a disposal problem to a general farmer, even in the U.S.

Whereas in the past all grain produced has been largely used for human consumption, Uganda realizes it will not be long, under the present rate of agricultural progress, before farmers begin to produce more grain than they can utilize for food. Already there is a demand for grain to feed high producing dairy cattle and this demand will soon spill over to the beef producers; particularly those producers with improved stock.

Beef cattle utilize cash crop by-products. As the world prices for coffee and cotton (Uganda's chief cash crops) continue to decline, beef cattle will be used to utilize cash crop by-products such as oil seed meals, from the processing of soybean, cotton seed, and ground-nuts. Consequently, cattle would increase the margin from these crops.

Under Uganda's climatic conditions beef cattle require a relatively small investment in buildings and equipment. This is an advantage because lack of initial capital has hitherto been one of the limiting factors to young Ugandans who would like to get into livestock production. Average investment in buildings, equipment and animals is less than in the dairy enterprise. Cattle can be left out in the field all year around.

Beef cattle require little labor relative to dairy cattle and pigs, or with cultivated crops occupying an equal area of land (Snapp and Neuman 1965). Although labor is still

cheap in Uganda, this situation will not last long as industries develop. There will soon be a competition for labor and it is those farm enterprises which need less labor per marginal income that will be better off.

Beef cattle entail little death risks. They enjoy an advantage over other forms of livestock since they are subjected to fewer ailments and disease that are likely to drastically curtail production or terminate in death. This is not true with dairy cattle, hogs or poultry. Beef cattle are not seriously injured by improper methods of feeding and are capable of giving a rapid economic response when feeding management is corrected.

III. UGANDA CATTLE BREEDS AND THEIR DISTRIBUTION

There are three well defined breeds of cattle in Uganda; the Ankole Longhorn, the Small East African Zebu and the Nganda. They are all more of the beef type than dairy (Joshi 1957).

(1) Ankole Longhorn:

The ankole Longhorn cattle are usually referred to as being of the Sanga type which is considered to have been evolved from the intermixture of the Lateral-horned Zebu and the Hamitic Longhorn (Bonsma 1951). Curson and Thornton (1936) described the routes which these cattle might have taken when accompanying human migrations. They stated that "the Southern stream probably passed through Uganda and followed the great lakes until the Zambezi was reached".

The breed has also been spoken of as Bahima (Uganda and the Congo), Watutsi (Ruanda and Tanzania) and Barundi (Lake Kivu) depending on the tribes and districts with which they are associated.

In Uganda, Ankole cattle are large animals with straight backs and with predominantly cervical humps, well developed in the male but less so in the female. The horns are generally long and sweeping, though polled animals also occur. The predominant coat color is dark-reddish brown though red, red and white, black, and back and white are frequent. There is no fixed true breed-color (Joshi 1957).

The average weight at maturity is 1300 lbs. in males and 900 lb. in females. The animals are tall and have long legs. The hair is very short and soft and the skin fairly loose with dark pigmentation (McCall 1926).

Functional Characteristics of the Breed:

The Ankole cattle of Uganda are larger than those in the Congo, but have the reputation of being less hardy than other breeds in Uganda. However, no scientific data are available to support this. In an improved herd the bulls attain their maximum size in five years of age. The females calve for the first time at 3.5 to 4 years. Calving interval may vary between 18 months to 2 years depending upon grazing conditions. Buckley (1953) reported milk production of 9.21 lb. per day per cow in 1952 from an Ankole herd maintained at a Goverment Stock Farm since 1938.

On good pasture Ankole cattle fatten well. At 4 years the steers weigh roughly 700 lb, and dress between 45 and 50% when slaughtered.

(2) The Small East African Zebu:

The Small East African Zebu Cattle are sometimes called Bukedi (Joshi 1957). On account of the concentrations of these cattle in the Teso, Lango and Kyoga areas of the Eastern and Northern Provinces of Uganda, they are accasionally referred to by names of these districts. The Assistant Commissioner of Veterinary Services, Uganda (Personal Communication) states that it is probable that the E. A. Zebu were established in Uganda before the arrival of the Ankole longhorn although some other authorities maintain the contrary (Joshi 1957).

Conditions of the Native home of the Breed:

The Small East African Zebu cattle are in highest concentration in the Eastern and Northern Provinces of Uganda. The type area is situated roughly between 32° 5' and 35° E and between 0° and 4° N. The area consists of undulating plateau varying between 3,000 feet to 6,000 feet above sea level. Most numbers are found in the basins of Lake Kioga and the surrounding area of the Northern portion of Lake Victoria. This area consists of low shell-lacked hillocks sloping gradually to intervening swamps, many of which dry up during the dry season and are used for pasturage.

The high plateau land and mountain ranges intersected by valleys result in varying climatic conditions as do the extensive lakes and swamps. Large diunnal temperature variations occur so that mean temperatures alone are a poor indication of climatic conditions of the area. The peak rainfall periods coincide roughly with the equinoxes. The first occurs in March to May and the second in September to October. The two dry seasons vary in length according to geographical position and extend one to two months before and after January and June respectively.

TABLE 1. A Typical Average Annual Climatic Data for Uganda

Lira (3,600' A.S.L.)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean max. temp. °F	91.7	91.7	88.8	87.0	82.9	82.5	80.1	81.8	83.6	85.4	86.9	87	85.8
Mean min. temp. °F	60.0	62.3	63.8	64.4	63.8	62.6	62.5	62.1	62.2	62.1	61.1	59.4	62.2
Humidity at 8:30 a.m.	54	58	72	83	80	79	84	80	80	75	72	65	74
Humidity at 2:30 p.m.	31	32	43	49	61	60	62	61	55	50	46	40	49.2
Rainfall (inches)	1.03	0.98	3.18	7.11	8.72	4.41	4.23	8.33	5.67	5.03	3.35	2.23	54.4

Characteristics of the Breed:

The Zebu cattle are small in size and rather stocky in appearance. The horns are short, thick at the base and curve slightly outwards and inwards. The musculo-fatty hump is prominant. Coat coloration is variable.

The liveweights of male and female Zebu from the records of a Zebu herd maintained at Serere Research Station are given in Table 2 (Williams and Bunge 1952).

Table 2. Liveweights of female and male Zebu herd.

Age in Months	Males	Females
At Birth	40	35
6	124	114
12	205	173
24	362	314
36	530	453
48	647	537
60	716	555
72	794	580
84	804	576

The heaviest bull in the herd in 1956 weighted 1,200 lb. Work oxen weigh up to 1,000 lb. (Uganda Protectorate 1955).

The average milk records of Zebu cows maintained at the Veterinary Department's Livestock Station at Entebbe are summarized in Table 3 (Uganda Protectorate 1953).

Table 3. Average Milk Records of Zebu Cows.

Year	No. of cows in herd	No. of Completed Lactation	Milk Yield (lb.)	No. of days in milk	Calving Interval	Range in Milk Yield(lb) Min.	Max.
1949	27[1]	25	1683	223	350	967	3250
1950	36[1]	29	2066	274	388	817	3563
1951	15[2]	14	1770	249	356	697	3555
1951	15[3]	13	2701	260	380	2263	3252
1952	12[2]	9	1956	251	778	1278	3207
1952	17[3]	16	2505	259	390	1657	3100

* NOTES: 1 Cows milked with calves suckling and cows completely milked. To the yield of cows suckling calves 80 gal. were added as the milk estimated to be taken by the calf.
2 Cows entirely milked
3 Cows suckling calves - 90 gal. added to yield.

The Zebu is a slow grower and even under the best of management, it is not capable of much more than 1.0 lb. liveweight gain per day. The limiting factor seems to be genetic rather than nutritional (Strobbs 1965, Joblin 1965). However the breed has several advantages:

1. It is fairly resistant to East Coast Fever (tick-born disease). Although ticks can be controlled by regular spraying and the use of clean pasture, most farmers do not spray regularly and a lot of them still graze their cattle on common land which is infested with ticks. A resistant breed is therefore, an asset to prevailing conditions.
2. The Zebu is a very efficient grazer. Grazing habits of Zebu cattle have been studied and reported on by Harker <u>et al</u>., (1954). The cattle graze individual

leaves on a stemmy grass, e.g., mature _Hyparrhenia rufa_. They can therefore survive very dry conditions under which European breeds would not do well.

3. The breed is very prolific.
4. The breed as a whole is docile and makes good dams.

Disadvantages:

1. The breed is slow maturing.
2. It has a very low rate of gain which makes supplementary feeding uneconomic.

(3) Nganda cattle:

The Nganda cattle had their origin in the crossing of the Ankole and the Zebu. Crossbred stains occur along side the pure parent types in those areas where the parent types exist. The cattle type is not stabilized on account of constant intermixtures with either of the parent types, and it may, therefore, not yet be sufficiently well established to justify classification as a breed.

The breed is concentrated along the shores of Lake Victoria in Buganda Province. It is a dual purpose breed and is reported by Joshi (1957) to show superior productivity to either Ankole or the Zebu.

IV. PASTURES AND THEIR DISTRIBUTION:

In obtaining an overall picture of the major grassland zone in the country the Veterinary Department (Uganda Protectorate 1953) reports four such zones each characterized by a series of grasses.

Zone I: The highland area of Southwest is predominantly Kikuyu grass (Pennisetum clandestinum).

Zone II: The plains of southwest are principally Red Oat (Themede triandra) and Rhodes grass (Chloris gayana).

Zone III: Regions along the Victoria shores where rainfall is above 50 inches are described as long grass zone. Elephant grass (Pennisetum purpureum) is the dominant grass in the area.

Zone IV: Most of the Northern part of the country falls in this zone. Rainfall in this area is usually less than 45 inches and Hyparrhenia rufa is the dominant grass. Panicum maximum is also well distributed in this zone particularly where the soil is deep or has been previously disturbed.

In recent years considerable scientific effort has gone into evaluating the most suitable pastures for the arable cropping areas of Uganda. Table 4 shows nutritive values of dry matter bassis of major grasses in Uganda Pastures.

TABLE 4. Animal Feeding Stuffs.

Nutritive Values on Dry Matter Basis.

	CP	CF	DCP	TND	Ca	P
FODDERS						
Green Grasses:						
Chloris gayana (Rhodes grass)						
3 - 5 inches	14.4	30.0	9.3	57	.39	.56
10 - 14 inches	12.8	27.2	8.0	60	.53	.47
Some flowers	6.6	29.8	2.9	58	.54	.29
Full Flower	7.2	29.1	3.4	60	.61	.40
Cyndon dactylon (Star grass)						
4 - 6 inches	25.0	22.7	20.4	63	.40	.52
6 inches	18.9	22.5	14.9	62	.58	.42
7 - 9 inches	11.5	24.6	7.0	62	.67	.22
Full flower	8.3	30.3	4.2	60	.69	.15
Hyparrhenia rufa						
Young leaf	14.5	27.1	9.5	59	.46	.29
Leafy	9.1	35.0	4.6	54	.35	.20
Stemmy	4.6	41.2	1.4	48	.22	.14
Flowering very stemmy	3.8	42.3	1.0	46	.23	.12
Panicum maximum (Guinea grass)						
Trans Nzoia var. Full Flower	12.0	34.7	7.0	55		
Mackinnon Road var. Full Flower	8.7	37.0	4.3	54	.40	.14
Pennisetum clandestinum (Kikuyu grass)						
Young	20.8	22.8	15.9	62	.33	.24
Medium	16.9	24.1	11.9	61	.46	.29
Mature and dry	10.9	22.3	6.5	63	.40	.17
Pennisetum purpureum (Elephant or Napier grass)						
Young	11.4	32.7	6.6	55	--	--
Pennisetum stramineum						
Young	6.1	37.2	2.4	53	.52	.12
Medium	4.6	37.6	1.5	52	.47	.10
Mature and Dry	2.4	40.0	0.4	40	.31	.05
Setaria sphacelata (Nandi)						
Young - 9 inches	15.1	22.9	10.3	62	.38	.23
Medium - 22 inches	12.5	26.8	7.8	61	.31	.22
Mature	5.2	42.4	1.8	49	.26	.09

TABLE 4. (Continued) Animal Feeding Stuffs

	CP	CF	DCP	TND	CA	P	DM
FODDERS							
Green Grasses:							
Themeda trandra (Red Oat)							
Young	6.7	35.2	2.9	55	.24	.12	
Medium	3.8	34.9	1.1	54	.47	.09	
Mature	2.7	34.7	0.5	42	.39	.07	
Silage:							
Maize (corn)							
Pre-forming cob stage	9.8	31.8	5.3	57	--	--	20
Hay:							
Chloris gayana (Rhodes grass)							
Young and leafy	14.7	28.9	9.6	58	--	--	91
Full flower	7.0	33.1	3.1	56	--	--	91
Penniatum clandestinum							
Young and leafy	14.1	28.4	9.1	58	.49	.30	90
Sataria sphacelata							
Young and leafy	15.1	28.7	10.0	58	--	--	90
Succulents:							
Musa (banana) leaves	16.0	20.0	11.3	64	.60	.20	20
Mangolds (yellow globe)	12.4	7.5	8.4	74	--	--	13
Concentrates:							
Grains: Maize	10.2	1.7	6.6	81	.05	.30	85
Sorghum	12.2	5.0	8.4	76	.03	.28	89
Legumes: Lupins	33.4	15.7	30.4	70	--	--	88
Soya bean	43.1	5.0	43.0	86	--	--	92
Oilseeds: Sunflower seed	24.7	32.4	19.2	58	--	--	92
Linseed	23.8	6.9	20.3	73	--	--	93
Linseed cake	29.9	13.2	26.8	72	--	--	90
Groundnut cake	48.5	4.6	48.5	78	--	--	88
Cotton seed cake	37.5	18.4	35.0	74	--	--	90

Uganda pastures are capable of giving production that compares favorably with anywhere else in the world. Dry matter yields exceeding 10 tons per acre have been achieved at Serere Research Station (Stobbs 1965).

Effort has been directed at improving pastures and management of cattle bearing in mind that most of Uganda beef must come from grass. A number of reasons accounts for this view:

(a) Raising beef cattle on grass is cheaper than feeding concentrates under Uganda conditions. Grain is still much too high in price.

(b) Grazing the cattle on pasture requires less labor for feeding and care than in grain feeding management.

(c) Very cheap gains are made on good pasture throughout the year.

(d) Local breeds of cattle are not potentially productive enough to make an economic utilization of high priced grain.

(e) With improved methods of roughage conservation a good feeding program can be maintained throughout the year regardless of dry season period.

V. AN OVERVIEW OF RECENT RESEARCH IN BEEF CATTLE PRODUCTION FROM PASTURE LEYS.

The object of the present scientific investigation in native pastures of Uganda is to make possible a system of ley

farming for the annual cropping areas of the country, which will prevent soil erosion, improve soil fertility and sustain higher profits from both animal production and also subsequent arable crops. The effect of the ley upon soil fertility has been well demonstrated (Ellis 1953). Over recent years considerable effort has been put into increasing animal production, in terms of beef, from leys (sown pastures), using Small East African Zebu, by selecting improved pasture species and also by improved management practices.

(1) Pasture Species:

Initial Selection was based on the following characteristics:

Yield: That total bulk of herbage produced in normal growing season.

Flowering Time: An indication of how quickly the grass will become stemmy.

Persistency: Ability to persist under a wide range of ecological conditions and management.

Palatability: Palatability is just as important, if not more important, than the actual chemical composition of the grass in terms of productivity.

Leafiness: Of leafiness Sir George Stapledon (Thomas 1962) writes, "As I have often said I feel pretty sure the most diagnostic feature and that of greatest economic importance is the quantitative and qualitative relation of stem shoots to leaf shoots under

the various contrasting conditions and at the different times of the year--this and amount of tillering in relation to time and treatment."

Compatibility: That is compatibility of any grass species in a seeds mixture.

Drought resistance: Ability to yield and stay relatively vigorous in dry months.

The initial investingation of grass and legume species was done prior to 1958 by the Veterinary Department. Over the period 1958 - 1965 seven grazing trials, using different evaluation techniques, occupying a total of 150 acres, each running for three years have been carried out to measure live-weight production from different sown pastures. On these trials bullocks of Small East African Zebu were allocated at random to each of the pasture treaments and groups of animal rotationally grazed, at weekly intervals over the half acre plots of their respective pasture, returning to the same pasture after four to six weeks.

Early work carried out in abscence of fertilizers resulted in the selections of Hyparrhenia rufa and a legume Stylosanthes gracilis for leys on poor soils; and Panicum maximum with Centrosema pubescens, for soils with good natural fertility. Chloris gayana, because of the spreading habit of growth, seeding ability and quick establishment was found to be beneficial when included in small proportions. Animal production from all unfertilized grass pastures, when stocked at one beast

per acre throughout the year, averaged 190 lb. per acre per annum over the three years of ley. The inclusion of legumes, particularly Stylosanthes gracilis and Centrosema pubescens in every case increased animal production, ranging from 11 to 49% compared with production from pure grass swards (Stobbs and Joblin 1966). The legumes tended to be slow to establish and over the first year their benefit measured through the grazing animal was small but their value increased over the life of the ley. This was particularly the case with unfertilized pasture where production from the sward, with the exception of H. rufa, fell off in the second and third year. The legumes produced nutritious growth during the dry season which is most valuable in Uganda where grass conservation in most cases is impractical and uneconomical due to low return obtainable from the cattle. Stobbs and Joblin (1965) showed that Centrosema pubescens was the most valuable in producing improved liveweight gains in the dry season compared with the rainy season. Palatability studies showed that Centrosema pubescens was accepted in the dry season but was relatively less palatable than Stylosanthes gracilis in wet season. It would appear therefore, that too much Centrosema pubescens in a sward is a disadvantage. Other legume species which have been tested and which show promise in pasture leys are Phaseolus atropurpureus, Desmondiun intortum and Lotononis bainesii. These legumes blend very well with such grasses at Panicum maximum, Brachiaria brizantha and Brachiaria ruziziensis.

(2) Fertilizers:

As a result of soil fertility investigations the major nutrient deficiencies of the Zebu cattle area was found to be nitrogen, phosphorus and sulphur. Herbage production from clipping trials showed that grasses responded markedly to nitrogen but not to phosphorus and sulphur in absence of nitrogen whereas pasture legumes responded very markedly to phosphorus and sulphur (Horrell, Court 1965). In 1960 a 21 acre grazing trial was laid down to test the value of applying artifical fertilizers to grass and grass legume pastures in terms of animal production and the yield of subsequent crops. The trial ran continuously for three years measuring animal production by means of a "Tester" and a "Grazer" technique (Blaser _et al_. 1956).

Production per acre from each of the treatments over a three year period (1029 days) is shown in Table 5.

The over all production per acre was high, particularly from fertilized grass legume pasture where production averaged 400 lb. liveweight gain per acre with 500 lb. liveweight per acre being produced in the first year. The legumes, _Stylosanthes gracilis_ and _Centroseme pubescens_ gave an increase of 49% in in liveweight without fertilizers and a 30% increase in the presence of nitrogen, phosphorus and sulphur. The inclusion of 3 lb. of legume resulted in 285 lb. in liveweight over the three year period without fertilizers and 172 lb. with fertilizers. Nitrogen application produced very highly significant increases in beef production. However, at present prices of beef it cannot be considered economic in beef producing areas other than to improve botanical composition of the leys.

TABLE 5. Animal Production from Grass, Legume, Fertilizer Trial - L W G. Per Acre (lb.)

Year	G/-	GL/-	G/N	GL/P SL	G/NP SL	GL/NP SL	Mean	Se/plot	L.S.D. 0.05	L.S.D. 0.01	L.S.D. 0.001
First Year (343 days)	239.7	323.7	386.9	327.8	414.6	474.6	361.1	71.4	24.6	33.2	44.0
Second year (343 days)	218.3	307.1	293.4	333.1	302.3	398.6	308.8	56.7	19.6	26.4	35.0
Third Year (343 days)	125.1	237.1	255.2	284.3	288.9	304.6	250.2	74.4	25.8	34.8	46.1
Total All Years (1029 days)	583.1	867.9	935.5	945.2	1005.8	1177.8	919.1	204.8	130.8	174.0	226.5
Mean	194.4	289.3	311.8	315.0	335.2	392.5	306.3	68.3	43.6	58.0	75.5
Percent Grass/-	100	149	160	162	172	202					

The application of phosphate to grass legume swards increased animal production to the level of grass sward which had recieved nitrogen but at a very much lower level. This is because phosphatic fertilizer is produced and processed in Uganda and is consequently the cheapest fertilizer in the country. The application of 2 cwt. of single superphosphate per acre per annum to grass/legume sward on another trial resulted in a 61% increase in liveweight gain compared with production from the same ley without fertilizer. This data, together with information from test cropping suggest that the use of single superphosphate on grass/legume mixture is the most economic proposition when herding Zebus. (Stobbs 1965)

(3) Stocking rate investigation:

The object of the investigation was to measure animal production from a *Hyparrhenia rufa*/*Stylosanthes gracilis* mixture sward at different levels of stocking and also to measure the effect of different intensities of stocking upon the sward. Information obtained from such an investigation would be of value to a progressive farmer. The treatments were:

(i) Fixed stocking 1 beast to 1.50 acres

(ii) Fixed stocking 1 beast to 1.00 acres

(iii) Fixed stocking 1 beast to 0.50 acres

(iv) Fixed stocking 1 beast to 1.50 acres Dec. to Mar.
1 beast to 0.50 acres Apr. to Nov.

(v) Variable stocking

Small East African Zebu steers rotationally grazed at weekly intervals, the half-acre plots of their respective treatments. The animal production from the first two years grazing is summarized in Table 6.

The results show a close correlation between stocking rate and production per acre. Indigenous Zebu stock with a potential growth rate of under one pound per day, apparently need to be stocked heavily in order to give a good production per acre. Total animal production at one beast (approximately 700 lb.) to 1.5 acres was only 281 lb. per acre over the first two years of the trial compared with 773 lb. from one beast to 0.5 acres. It is obvious that at that kind of growth rates it would take a further 3½ years to achieve the production that the beast to 0.5 acres did in two years.

Cattle at the heavy stocking rate tended to lose weight during the dry season but the quality grass came up with the rains the cattle showed exceptional growth. The results emphasized the loss in animal production in dry season and the need for grass conservation in wet season when the pastures are understocked.

Severe defoliation in the dry season does not seem to greatly affect regrowth of pasture when rains break. There is, however, a reduction of percent legume in the sward. The most critical time of the ley would appear to be at the commencement of the rains. This is the time a farmer would be careful in stocking his sward and try to avoid incidence of poaching.

TABLE 6. Animal Production at Various Stocking Intensities - L.W.G. per acre (lb.)

		L.W.G./acre (lbs.			Grazing Days/Acre	Av.L.W.G. per acre	per Beast per day
		1963-64	1964-65	Total	(668 days)	1964-65	1963-65
(i)	1 Beast to 1.5 acres	162	119	281	448	0.53	0.63
(ii)	1 Beast to 1.0 acres	239	222	461	672	0.66	0.69
(iii)	1 Beast to 0.5 acres	407	366	773	1344	0.54	0.58
(iv)	1 Beast to 0.5 acres (April-November) 1 Beast to 1.5 acres (December-March)	331	322	653	1133	0.58	0.57
(v)	Variable stocking	258	341	599	1171	0.53	0.51
Mean		279	274	553	953	0.56	0.58
P = 0.05		89.8	170.2	93.9			
0.01		121.1	233.8	125.0			
0.001		161.0	308.6	162.6			

The treatment which allows for the sale of cattle for the Christmas markets, treatment (iv), is of practical value to the farmer. It gives the farmer the best result at the right time.

The average growth of stock is 0.56 lb. per day. The larger the grazing area available per animal the greater the daily gain; but in the latter part of the second year the pastures on the one beast to 1.5 acres tends to become highly lignified and result in poor animal production. The results from the variable stocking treatment emphasize the subjectivity of estimating the carrying capacity of a pasture ley.

(4) Grazing Management:

Night grazing, particularly at times of pasture shortage, was shown to be necessary to achieve optimal animal production in short grass areas of the country (Joblin 1960). The system of grazing management had a less pronounced effect although there was an overall trend in favor of a three paddock system when compared with strip-grazing regimen (Joblin 1963). When strip-grazing, 3-paddock and 6-paddock rotational grazing were compared with continuous grazing, there was no significant differences in terms of liveweight gain per acre. Continuous grazing therefore would appear to be a more preferable system because it is cheaper than the rest in terms of labor, equipment (e.g., water troughts, gates) and fencing expense.

(5) Type of Stock:

Although annual animal production of up to 500 lb. per acre can be achieved from Small East African Zebu stock it becomes increasingly obvious that as the environment improves there is a need for stock with greater growth potential. With low producing animals a larger portion of nutrients is used for maintenance. Analysis of the nutrients required for maintaining the Zebu cattle and those going into production was carried out for the animals on grass/legume pasture for a period of three years, (Stobbs 1965). The proportion of nutrient going into the animal production was only 24.5 ± 9.4%. These figures are very much lower than comparable figures from the United Kingdom where 50 - 70% of nutrients go into production (Stobbs 1965). Inspite of lack of extensive knowledge about the nutrient requirements of Zebu cattle it would still appear that there is a very great waste of nutrients when cattle are only capable of producing about half a pound per day gain (Table 7).

TABLE 7. <u>Stock Performance</u>

	1964	1963	Previous Mean	Years in Mean
Suckling calves (lb. per day) (A.D.G. from birth to weaning)	0.74	0.75	0.72	1952-64
Calf mortality %	23.3	23.8	21.4	1941-64
Heifers (lb. per day) A.D.G. weaning to 3 years old)	0.50	0.53	0.38	1945-64
Steers (lb. per day) (A.D.G. weaning to 3 years old)	0.48	0.50	0.43	1945-64
All stock on the farm (lb. per day)	0.31	0.32	0.32	1949-64
Stock numbers 1st Jan. (i) Zebu	593	482	273	1949-55
(ii) All	786	644		
Growth from whole station (lb.) (i.e. Total daily gain from all stock) (i) Zebu	156.3	150.9	97.8	1948-55
(ii) All	220.4	211.8		

Table 8. Weight for Age Comparison of Unselected Stock in 1964 Compared with Previous Mean.

Year of Birth for 1964 Classes	Age	Sex	1964 (lb.)	Previous Mean Up to 1964 (lb.)	No. of years	Difference (1964 - Mean) (lb.)	% Difference
1964	Birth Weight	M	45.0	39.6	21	5.4	13.6
		F	39.9	36.5	21	3.4	9.3
		Av.	42.4	38.0	21	4.4	11.5*
1964 & 1963	6 months	M	197.0	166.8	20	30.2	18.1
		F	176.6	154.5	20	22.1	14.3
		Av.	186.8	160.6	20	26.2	16.2*
1963	12 months	M	307.6	249.1	20	58.5	23.5
		F	292.3	222.8	20	69.5	31.2
		Av.	299.9	235.9	20	64.0	27.3*
1963 & 1962	18 months	M	408.4	320.9	19	87.5	27.3
		F	391.8	283.0	19	108.8	38.5
		Av.	400.1	301.9	19	98.2	32.9
1962	24 months	M	523.0	406.2	19	116.8	28.8
		F	472.3	357.0	19	115.3	32.2*
		Av.	497.6	381.6	19	116.0	30.5
1961	36 months	M	750.1	563.0	18	187.1	33.2
		F	631.4	502.5	18	128.9	25.7
		Av.	690.7	532.7	18	158.0	29.7

* Shows improvement in performance in last 5 years by better management.

So far work carried out in an effort to determine the feasibility of producing beef cattle from pasture leys using the local Zebu, (Stobbs 1965), show the following points:

(1) Animal production from local Zebu cattle makes it possible for the pasture phase of the rotation to be an economic proposition. However, great care is needed to decide what inputs are economically desirable and what are practicable to a progressive Uganda farmer.

(2) Legumes, particularly Stylosanthes gracilis and Centrosome pubescens contribute greatly to give increasing animal production. Although fertilizers are valuable for increasing herbage yield (viz, nitrogen, phosphorus, and sulphur and muriate of potash), only the locally produced single phosphate can at the present time be considered to be economic in the beef producing areas of Uganda.

(3) Stocking rate is one of the most important factors affecting beef production per acre.

(4) System of grazing management seems to have only a small effect upon animal production provided internal parasites are controlled.

(5) As the environment improves, more productive stock will be needed.

In search for more productive stock capable of economic response to improved management, attention has been turned to temperate breeds and the Boran (Brahman).

One might ask: "If the indigenous breeds of cattle are genetically inferior in production under improved management, why don't you fellows get rid of them and replace them with the European breeds, regardless?" Before one can accept or discard such a course it is necessary to know how these European cattle breeds adapt themselves to tropical environmental conditions.

VI. BREEDING

(1) Adaptability of temperate breeds (Bos taurus) to the tropics:

Research workers in the tropics have been interested in finding out the influence of tropical environment on performance of the British breeds of cattle. Hammond and Bonsma (1955) reported that European cattle are not heat tolerant and suffer from hyperthermia on hot days, resulting in loss of appetite and difficulty of movement. In semiarid tropical regions where vegetation is sparse, particularly in dry season, ease of movement is essential. They also reported that the growth of late maturing portions of the body such as the loin and rump is retarded. Affected cows tend to have low fertility and commonly exhibit calving difficulties or produce a high incidence of dead calves as a result of insufficient development of the pelvic region. Hammond and Bonsma (1955) reported that two cows of the same age, one an Aberdeen Angus and the other an Afrikander, were maintained under identical conditions. At five years of age the Aberdeen Angus had produced one calf and weighed 651 pounds, whereas the Afrikander had produced three calves and weighed 1,100 lb.

Lack of the pigmentation of the skin poses a problem. Hammond and Bonsma (1955) reported that ultraviolet radiation from sunlight causes irritation of the skin of cattle which lack pigmentation. This is a cause for streptothricosis, hyperkeratosis, and vulnerability to cancer eye.

(2) Growth of European Cattle in the Tropics:

Hancock and Payne (1955) reported the results of an experiment conducted with eight sets of twin calves. One calf of each set was sent to a location in the Figi Islands and the other to New Zealand. Feeding and management were identical in both locations, the only difference was climate.

Growth rates, feed intake and temperature data were recorded. The depression in growth rates of the Figi Island groups was pronounced when the temperature was at its highest and the apparent efficiency of food conversion was at its lowest. The animals were 15 months old at the beginning of the experiment. This resulting size difference continued until calving, at which time the average difference in weight between the two groups was 84 lbs. or 9.6%.

The suppression of growth in the Figi Island animals appeared to be uniform in regard to all body measurements except for belly girth. The increased belly girth of the Figi Island animals was attributed to greater water intake, being about twice that of the New Zealand group.

Hancock and Payne (1955) concluded that the stunting apparent in the European cattle on the Figi Island, could largely be attributed to the effect of climate.

(3) <u>Beef Cattle Response to High Temperatures:</u>

Many reports indicate that production is lowered in European breeds of cattle during the hot season in the tropics and during summer in subtropics; and that tropical breeds are more heat tolerant than the European breeds. Little information, however has been reported on the physiological and anatomical differences responsible for varying degrees of adaptability.

Cartwright (1955) reported on an experiment in which eight animals of various breeds were subjected simultaneously to a temperature of 105^{o} F and a relative humidity of 50% for a period of eight hours in a heated chamber. A total of 366 animal observations were made. Analyses of data revealed significant breed differences, with Herfords high and Brahmas low for body temperature and respiratory rate. Similar differences were found for respiratory rates taken in the field. The more heat tolerant cattle also made greater body weight gains during the summer while on shadeless pastures. Since most tropical savannahs are treeless under range conditions, this observation has important practical application. It was also observed that summer gains appeared to be fairly highly heritable (19%), indicating the possibility of effective selection for that trait. Summer gain and winter gain appeared to be negatively correlated between breeds but independent within breeds.

It was apparent that summer or hot season gain was potentially the most useful for selection for heat tolerance under practical conditions of the various traits studied.

(4) Heat Tolerance in Cattle:

Hancock and Payne (1955) defined heat tolerance as an animal's ability to escape the adverse consequences of hot climatic conditions. Rhoad (1944) defined it as the manner in which an animal as a unit reacts to high environmental temperatures. Hancock and Payne (1955) commented on the general problem of the breeding improvement of cattle maintained under adverse climatic conditions. They suggested that emphasis should be placed on research directed toward the identification of desirable hereditary factors determining productivity and heat tolerance. They stated that selection should be based on judgement instead of rules and that research workers and producers must cooperate to the fullest extent.

Techniques whereby the heat tolerant animals may be separated by selection from those that are not so tolerant, have been proposed. Rhoad (1944) developed the Iberia Heat Tolerance Test which is based on the observation of the elevations of the rectal temperature of animals exposed to the sun on hot days. Lee (1955) also investigated this problem in Texas. By observation and experimentation, both in the field and in the laboratories, some information of the relationships between the rise of rectal temperature and factors such as cattle breeds, environmental temperatures, relative humidity, air movement,

and nutritional status have become available. Basically the Iberia Heat Tolerance Test involves the assumption that the rise in the animal's rectal temperature is the most important physiological response to high environmental temperature and that this temperature increase is intrisically associated with adverse physiological responses. Other reasons not associated with rectal temperature are considered comparatively unimportant. Many physiologists maintain that cattle perform at a satisfactory level in spite of relatively high rectal temperatures, but may accomplish even greater gains if not subjected to such high environmental temperatures. It may also be stated that an animal with the same productive potential but with higher heat tolerance would give the same returns as animals with high productive potentials and lower heat tolerances. (Lee 1955).

In view of the above considerations regarding European breeds in the tropics, an outright introduction of European breeds would not be a lasting practical proposition. Uganda needs to turn to breeding programs using both European breeds and local breeds in order to get the type of animal suitable to Uganda conditions. An animal which is an efficient converter of roughage and other vegetable products into meat; and which incurs least cost in production, but maximum possible quantity of desired products as reflected in the selling price.

(5) Systems of Animal Breeding:

Grading: The practice of grading was the one mainly responsible for the development of the American commercial

cattle industry. This breeding plan involves the continuous use of purebred sires in herds which generally have originated from nondescript females. Upon the initiation of this program the first generation offspring possesss 50% of purebred breeding. When those in turn are mated to purebred sires of the same breed, the resulting offspring possesss 75% of the the purebred breeding. After six top crosses by this method, the animals produced should be approximately purebred merit for all practical purposes. For real success the continued use of purebred sires should be practiced on high grade foundation herds.

Outcrossing: Outcrossing within a breed is usually defined as the mating of animals which possess no relationship within the first four to six generations of their pedigree. This system has been probably the most widely used animal breeding system, breeders have continuously attempted breeding improvement through the introduction of unrelated sires into the breeding herds. In addition to the potential value of this breeding plan for obtaining and introducing new desirable genetic material into herds, it is instrumental in maintaining a relatively high level of heterozygosity within a purebred herd. This particular aspect is usually considered desirable in commercial breeding herds. However, it is antagonistic to the establishment of high degrees of genetic purity in purebred herds. Lush (1945) described outcrossing as a breeding system which generally leads to individual excellence but of low breeding worth. Outcrossings tend to hamper breeding progress because they destroy distinct

families and make entire breeds temporarily more uniform than other breeding systems which involve the mating of related individuals.

Crossbreeding: Crossbreeding includes several types of outcrossing matings outside of a single purebred breed. It generally refers to the mating of purebred animals belonging to different breeds but may also refer to the mating of animals belonging to certain different species.

Crossbreeding combines divergent sources of germ plasm which may result into considerable uniformity in the first generation but usually gives rise to pronounced variation if crossbreds are mated together to produce an offspring. Crossbreeding is credited with increase of size, vigor, and fertility in a commercial breeding herd. It can be stated that the primary reason for crossbreeding is the increase of vigor in the production of a meaty animal, Lush (1945).

Winters (1948) reviewed the crossbreeding experiments with cattle. Crossbreds produced by usage of the English breeds have reportedly excelled the purebred in regard to most production traits in practically all of the experiments. It should be noted, however, that the general productive merit of cross breds appears dependent on the productive merits of the parents. Crossbreeding should not be advocated as a breeding system capable of yielding phenomenal results, but in systematic application it can improve cattle production.

Inbreeding: Inbreeding is sometimes defined as the mating of animals which are more closely related than the average

of the breed which they represent. In a broad sense all animals of a breed are related; however, in reference to inbreeding the relationship is necessarily high. According to Rice and Andrews (1957) the mating of individuals possessing common ancestry within the first four to six generations of their pedigree should be classified as inbreeding. Since inbreeding involves the mating of animals of various relationships, inbreeding is variable in regard to intensity. Inbreeding may be techinically divided into two categories: closebreeding, which is commonly referred to as inbreeding, and linebreeding. Intense breeding is usually termed inbreeding, whereas mild inbreeding is usually referred to as linebreeding. Both of these constitute inbreeding but at different levels of intensity. The mating of full-sibs or parent to offspring are definitely classified as inbreeding. Half-sib matings and the mating of individuals related to a lesser extent are usually classified as linebreeding.

The primary effect of mating related animals is that it facilitates homozygosity and lowers heterozygosity in the offspring. Inbreeding does not alter gene frequency but permits it to drift rapidly at random in each sub group of a population and enables selection to change gene frequency more effectively than other breeding systems (Lush 1945).

Intense inbreeding is bad because it may make genes homozygous at a rate too rapid to be alleviated by selection. Inbreeding generally results in decrease in size and vigor and may likewise reduce reproductive efficiency in a breeding herd.

(6) Inheritance of Traits in Beef Cattle:

Investigators and producers of Uganda must be able to identify traits of economic importance in beef cattle and heritability of these traits if they are going to benefit from a breeding program. Knowledge of economic traits and their heritability is not, and should not be, academic but a practical necessity to livestock improvement.

During recent years a large amount of interest has been placed on studies on inheritance of traits which are of economic importance in beef animals all over the world. These traits are generally referred to as economic characters. These characters are generally quantitative or their genetic variation is determined by a large number of pairs of allels and there is usually considerable variation which is due to environmental factors.

Genetic variation is of three sorts, viz., additive, dominance, and epistatic. Additive variation presumably expresses its presence when it occurs in a phenotype. In this event, progeny average half way between the phenotypes of their parents. Dominance and epistatic variance are hereditary in the broad sense, however, these do not behave in the simple additive manner. In this case phenotypes are not so clearly indicative of probable genotypes (Lush 1945).

Heritability estimates may be computed for all measurable economic traits. However, it should be emphasized that computed values are merely estimates. Many factors, particularly sampling

errors, cause considerable variation in heritability estimates of the same character. It appears justifiable, however to refer to several estimates in the general evaluation of the heritability of the various traits in beef cattle. Some heritability values of economic traits in beef cattle are summarized in Table 9.

Table 9. Heritability of Various Production Traits in Beef Cattle

TRAIT	HERITABILITY	REFERENCE
Birth weight	.53	Knapp, Clark (1950)
Weaning weight	.11	Dawson et. al. (1946)
Weight at 15 months	.28	Knapp, Clark (1950)
Gain during feeding trials	.65	Knapp, Clark (1950)
Rate of gain in feeding trials	.77	Knapp, Clark (1950)
Slaughter grade	.45	Knapp, Clark (1950)
Carcass grade	.33	Knapp, Clark (1950
Area of longissimusdorsi	.68	Knapp, Clark (1950)

If heritability values are in excess of .30, it is generally considered high and mass selection of the basis of phenotype or individuality is relatively effective. In the case of low heritability values, it is assumed that phenotype is not a reliable indication of genotype or breeding merit.

(7) Phenotypic Selection of Beef Cattle for Efficient Production:

By applying knowledge of judging beef cattle for functional efficiency and using this tool hand-in-hand with

performance and progeny testing, Uganda producers can greatly improve their beef cattle production.

"Guideposts" in Bull Selection: Cattlemen have often said "The bull is half the herd." That this is largely true even today is evidenced by the large sums of money being paid for good breeding bulls. Here are some of the points on which selection of a bull should be made in addition to a comprehensive genetic record (Scruggs 1965):

1. Strong masculine appearance.
2. Full, heavy, and clearly defined muscling. He should be well muscled; not heavily covered in fat. A completely smooth fat covering is not characteristic of a highly fertile bull.
3. Darkening of the hair in the front quarters with a sleek, shiny, smooth hair coat. No bull, if he is one, should have absolutely uniform hair color.
4. Masculine crest with well defined muscles in neck and shoulders.
5. Well sprung ribs and strong back -- the low fertile bull looks deep but has flat ribs when looked at from the rear.
6. Well formed reproductive organs of the proper size. Usually reproductive organ abnormalities are heritable and the producer should be on the look out.
7. Strong, well-muscled legs and strong pasterns.

8. Good overall proportion. Unduly large head, too much overall compactness may lend to calving problems of offspring or threaten dwarfism.

Most cattlemen have seen these characteristics in their cattle but few, if any, recognize and understand what they mean. The challenge to a Uganda producer or Uganda animal scientist is to understand these characteristics and then use them to select for highly fertile animals.

Fertility signposts in Cows

	High fertility	Low Fertility
Head	Fine and feminine, smooth hair, looks sleek and slightly greasy	Coarse, with coarse hair on upper regions of the head and brittly hair on the crown - hair dry.
Mandible or Lower jaw	Fine, and teeth fit on dental pad. Free from excess fleshness	Heavy - and lower jaw tends to be over that. Tends to be heavily fleshed, giving cheek a rounded appearance.
Eyes	Calm and medium size	Often prominent and exophthalmic. Blindness often causes impairment of sexual function.
	Skeletal differences	
Scapula	Light, and upper cartilagenous ridge as high as the upper region of the spinous processes (vertebrae)	Heavy and fleshy, upper edge of the scapula appreciably lower than the highest point of the spinous processes.

Spinous process	Level	Incline steeply dorsally, a rising chine.
Front and rear ribs	Appear to be of the same length	Differ very much in length. Overgrowth of the front ribs. Deep through chest like a buffalo.
Rump	Distance from hip to bone to pin bone, long	Short
Distance from Hip to Patella	Great	Short. Patella gives the impression of being too high.

<u>Muscle development and fat deposition</u>

Neck	Lean and flatt and smooth	Rounded, heavy, and muscles inclined to be clearly defined.
Shoulders	Light, lean, and free from fleshness	Seem to be well fleshed and between shoulders heavily fleshed.
Brisket	Lean, and a skinfold along the edge	Heavy, full, no skinfold sloping in a dorsal and ventral direction.
Midrib region	Free from fat deposit	Exhibits rounded fat deposits and rounded between ribs.
Pinbone	Clearly defined and free from fat deposition	Pinbones and tail setting well covered in fat

<u>Hide and hair</u>

Face and Neck	Smooth and sleek	Course and waxy, masculine pattern
Crown and Top of Neck	Short and smooth	Course and along the neck to shoulders bristly and upright.

Barrel and Sides of Ribs	Smooth and sleek and give impression of slight oiliness	Dull and long, lack gloss and look dry.
Hair characteristics	Hair uniformly pigmented, smooth throughout.	Darkening of the hairon the cheeks, neck, sides, and flanks like in the case of bull.
Length of hair on udder	Short greasy hair on the udder and the teats are smooth and glassy	Long silky hair on the udder, the hair is dry and dull and the teats wrinkly and dull.

(8) Progress so far with Exotic Cattle Breeds:

In 1958 it was realized that breeding programs which relied entirely on local stock were long term projects. Worse still, the genetic potential of the local stock fell far short of the progressive farmer's requirements. It was therefore considered desirable to find out if any of the improved breeds of beef or dual purpose cattle could be adapted to the local conditions more rapidly than the indigenous cattle could be brought up near to their standards by selection.

Boran (Brahman in U.S.) cattle were chosen for initial investigation because of their excellent record for beef production under difficult tropical conditions and their known adaptability to a wide range of climatic conditions (Briggs, 1951). Also work done in the Southern United States indicates that the Boran (Brahman) is a better breed for crossing with other breeds to give a meaty animal under tropical conditions (Briggs 1951, Black et. al., 1934, and Diggins 1956). Other breeds which have been used are Aberdeen Angus and Red Poll.

The object in this field is an evaluation of the first cross from Aberdeen Angus/Red Poll and Boran sires on Zebu, Ankole and Boran dams and a comparison of crossbred animals with pure Boran and Red Poll cattle. It is intended to obtain results which can be applied to ranchers and arable farmers to increase profitability of their operations.

Table 10 gives preliminary results of the relative growth rates of the Red Poll and the Boran.

TABLE 10. Growth Rates of Red Poll and Boran Cattle

	Birth		3 Mo.		6 Mo.		9 Mo.		12 Mo.		18 Mo.	
	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
Red Poll												
Males	65	32	210	13	312	13	422	13	513	10	608	7
Females	57	32	190	24	293	23	408	22	481	19	585	13
Boran												
Males	42	19	184	15	304	15	390	6	435	2	555	2
Females	42	17	199	15	284	12	372	12	420	6	538	6

Table 11. Birthweights and Mean Daily Liveweight Gain

Type	Birth Wt. (lb.)	No.	D.L.C. 0-90 days (lb.)	No.	D.L. Wt. C. 90-180 days (lb.)	No.	D.L.C. 0-180 days (lb.)	No.
Angus x Ankole	55.6	22	1.35	21	1.41	14	1.38	14
Angus x Boran	57.5	25	1.59	24	1.68	18	1.62	18
Angus x Zebu	45.8	34	1.27	34	1.31	26	1.28	26
Boran x Ankole	63.3	31	1.28	29	1.20	28	1.24	28
Boran x Boran	58.3	54	1.38	48	1.32	43	1.35	43
Boran x Zebu	48.4	41	1.21	37	1.07	29	1.13	29
Red Poll x Ankole	51.1	19	1.18	17	1.26	10	1.18	10
Red Poll x Boran	54.2	32	1.46	27	1.46	23	1.45	23
Red Poll x Zebu	48.6	25	1.21	24	1.06	21	1.13	21

Because of the urgent need for good quality beef, both for home consumption and export market, and in view of the population density distribution, beef will be produced from two main sources -- ranches in thinly populated areas and arable farms in relatively heavily populated areas.

Ranching development schemes: Four main ranching schemes have been established during the last 3 years. They cover a total acreage of 225,000 acres. The scheme is designed to utilize land cleared of Tsetse fly for small individual ranches of some 4,000 acres in extent. The first phase of the scheme is to carry out initial demarcation work, boundry fencing, and the installation of water supply for each ranch before land is allocated. The government also builds internal roads, puts in fire breaks and provides advisory services for the ranchers. The scheme is financed by the U.S.A.I.D. Loan for which the nation is grateful. However, the ranchers have to pay for the development carried out on their land over a specified period as a condition of the terms of their lease. The ranches are provided with extension staff, offices , and labor lines and veterinary field service.

A ranching selection board receives applications and interviews prospective applicants and as a result of its recommendations, ranches are allocated. Before cattle are moved into a ranch they are treated with Berenil against Typanosomiasis, vaccinated against Anthrax, Black quarter, Haemorrhagic Septicemia and sprayed with Toxaphene. Cattle are sprayed regularly against ticks.

Other ranches are run by government agencies and it is hoped than a comprehensive breeding program will be carried out on these farms to produce high class bulls to distribute among the ranchers. Also these ranches will be used to develop a breed which will eventually replace the local breeds of cattle on ranches and on arable farms where management is of high standard. Just as the Southern U.S. has succeeded in producing the Brangus, Santa Gertrudis, and the Beefmaster, (Diggins and Bundy 1956) it is hoped to do something similar using local cattle, European breeds and the Boran.

For the time being calves born on these ranches will be weaned at 9 months of age and stay on the range until they are ready for the slaughter market. However, when the practice of irrigation is well established and the high energy feeds (concentrates) become available at an economic price, some of these ranches may produce feeder calves for fattening on grain.

VII. ARTIFICIAL INSEMINATION:

The first recorded successful artificial insemination (.A.I.) was done by Spallanzani in 1780 (Rice et al., 1957). By 1906 the practice had passed beyond the experimental stage. The first large-scale artificial insemination in the U.S. was organized in Clinton, New Jersey in 1938 (Rice et al., 1957) and by 1954, 2.5 million cattle in the U.S. were artificially inseminated (Rice et al., 1957).

This rapid increase of the practice is indeed a reflection of its advantages in the overall program of cattle improvement. The practice has the following advantages:

1) It increases the use of proven sires.
2) It provides a quick method of evaluating sires.
3) It eliminates need for a bull in a small herd, particularly in arable areas of the country.
4) It facilitates the mating of animals of greatly different size e.g., mating of Small East African Zebu with a Friesian Bull.
5) It extends the usefulness of sire that for some reason may have become incapable of performing natural service.
6) It results in animals of more uniform type and production.
7) Perhaps one of the outstanding advantages of the method is that it stimulates greater interest in better livestock - breeding and management practices.

In view of these advantages an Animal Breeding Center was set up in the country together with a number of field centers. A total of 27 field centers were undertaking artificial inseminations by the end of 1965.

The total number of inseminations carried out in 1965 was 6868 of which 4000 were with semen from European breeds and the Boran. Considerable problems still exist in providing an efficient service to farmers and ranchers. This is largely due to scattered nature of farms, the bad roads, inadequate

communication, and the time taken by the inseminator moving between farms. These factors may limit the number of inseminations which can be carried out by an individual inseminator to two or three cows a day.

The majority of inseminations is carried out with fresh semen diluted in coconut milk extender and sent out to field centers in insulated metal boxes twice weekly. With this extender, the motility tends to fall rapidly after seven days in storage but under practical conditions semen is used up in three to four days. Conception rate in the field, calculated on the 90-120 days non-return rate for a period September 1964 to August 1965, using coconut milk extender and liquid nitrogen frozen semen was asfollows:

Non-return with Coconut Milk Extender	65.1%
Non-return with Liquid Nitrogen Frozen Semen	51.6%

When investigations were carried out on a number of farms where poor conception rateswere obtained, the major cause of poor conception appeared to be the failure of owners to recognize heat periods and to call the inseminator in time. Silent heat also seems to be a problem. This could be caused by mineral imbalance particularly phosphorus deficiency (Hart et al., 1911, Theiler et al., 1928, Theiler and Green 1931). A survey carried out by a Nutrition Chemistry Section seems to indicate that mineral imbalance is caused by either calcium or phosphorus deficiency or both in some areas. The possibility of stress factors due to climatic conditions being involved in case of exotic breeds cannot be ruled out.

(1) Managerial Procedures Associated with Successful Use of A.I.

The farmer should make preparations for the A.I. Program long before the actual breeding takes place.

Nutrition Program:

Lack of proper nutrition is usually the main stumbling block to successful use of A.I. Cow ought to be fed liberally so that she is gaining weight at time of breeding. To make sure this is achieved, the feeding regimenshould be such that the farmer knows exactly what his cow is getting at each physiological stage of her life. This is particularly so in the dairy industry where individual feeding is more practiced. A well balanced ration in terms of energy, protein, minerals and vitamins A should be a must. Cows which lose weight towards breeding time are difficult to settle and thin cows usually show silent heat. Since a farmer has got to detect cows in heat, silent heats can spell economic ruin. Rations should contain adequate amounts of Vitamin A to ensure a high level of fertility.

The feeding stuff should also contain enough phosphorus and calcium in the right proportions (1.5:1). Low phosphorus rations (a likely situation when cows are largely dependent on roughage) cause a spread in calving interval and reduce percentage calf crop weaned. Phosphorus deficiency also tends to encourage silent heat.

Choosing a Bull

This is one major item a farmer should be concerned with particularly if he is going to rear his own replacements. Production and conception depend on good quality semen all other things being equal. The producer should plan to get an A.1 proven bull for best results a bull with an outstanding conception rate. For Uganda producers this is not yet a problem because there are still relatively few bulls to choose from and are all carefully screened by the Department of Veterinary Science.

Choosing a Technician

The farmer should plan well ahead to get an experienced and competent technician to do the job. A poor technician can be very expensive thus ruining all the previous efforts. Use of less expensive but incompetent technicians is false-economy. The technician should know all the theory, mechanics, and the art of handling semen all the way till semen is deposited into the cow's cervix.

On-the-farm Facilities Relevant to A.I.

1) There should be a specially designed holding pen for breeding cows. It should be designed to effect quick and smooth operation with a minimum of people (labor) and excitement to the cow.

2) A holding paddock for those cows about to be bred.

3) A supply of clean hot and cold water nearby.

4) The Breeding space should be under cover, well sheltered and preferably concrete floored to facilitate easy

cleaning. Proper sanitation is important in an A.1 program.

5) A well furnished and orderly office where records arekept.

6) Good relationship between farmer and technician. This is important if the farmer is going to get the best out of the A.I. service. An offer of hospitability to the technician should be part of the business.

7) A field where cows on heat can be kept before breeding. This prevents damage to other cows through mounting and possible fighting.

8) A nearby sheltered paddock to be used at calving time. Where A.I. is being used all calving cows should be watched closely. Difficult and unattended calving particularly for heifers may spell infertility thereafter.

Branding Program

To facilitate interpretation of records and decision making in persuit of high production, regulated production and general improvement of the genetic set up of the herd, all cows should be branded for identification. This enables the farmer to tell which cow should be bred to what bull and why. This also facilitates his efforts later when he is selecting replacements or picking out culls.

Calving Time

Difficulty at parturition and mismanagement at parturition and immediately after account for a percentage of

sterility particularly in heifers. It also reduces the milk flow potential of the cow. Just before a cow is due to calve, she should be brought to a nearby field and a cowman should keep an eye on her all the time. At time of calving, a cowman should be at hand in case of difficulty.

Heifers tend to be nervous and therefore they should be handled carefully and gently. They should be kept separate from bullying cows -- tension may interfere with their mothering ability or milking ability in case of dairy cows.

Uterine Involution Period

Recognition of this period is important for this reason: An over ambitious farmer may breed his cow too soon and if she does not settle he is liable to loose money, time and effort in the process. He may also cull out a good cow on the wrong assumption that she is not fertile (Salisbury, VanDemark 1961).

For best results from A.I., therefore, the cow should be allowed 60 days physiological and morphological rest after calving before being bred again. The cow should be bred on first heat after the 60 days but within 40 days period.

Heat Detection and Breeding Time

When cows are on grass, the farmer should keep an eye on those which show signs of heat during the forty days. After separating those in heat, provisions should be made that such cow is bred 18 hours after commencement of heat.

Old cows may tend to have very short heat periods and a large number of quiet heats (Morrison and Erb 1957, Tabade et al. 1946, Herman 1956). The farmer should be aware of this and pay particular attention to those old cows. Through records the farmer should know roughly when they are supposed to be on heat and be more attentive during this time. Balanced nutrition should alleviate this situation.

The farmer should also appreciate the fact that breeding efficiency of heifers is about 60% of old cows. He should not therefore be hasty in his decision if a heifer does not settle on first services.

Cleaning up Bulls

This is a practice which should be carried out on large operations as a safeguard. As a precaution the semen of the cleaning up bull should be collected just before he is turned out. His semen should then be evaluated. The bull should run with the cows for about 20 days after the 40-day breeding period.

Reproductive Efficiency Records

Records should be kept for a purpose and should be compiled in such a way that one can extract information from them quickly and accurately.

Records should be made to help the farmer in making decisions such as the following:

1) Choosing what sire to breed to what cow.

2) Selecting replacement heifers.

3) Choosing a culling program.

4) Avoiding inbreeding.

5) Identification of all animals.

6) Timing breeding season.

7) Programming feeding regimen.

Records Farmer Should Keep

1) Number of cattle.

2) Ear tag or chain number of cow.

3) Code number of sire.

4) Calving date of dam.

5) Heat period (days not bred).

6) Days fresh to first service.

7) First service date (and bull's identification).

8) Days between services.

9) Second service (Bull and date).

10) Days between services.

11) Days dry (should be about 60 days).

12) Date due to calve.

13) Calving date.

14) Weight of calf.

15) Code number of sire and ear tag of calf.

16) Calf's sex.

17) Weaning weight.

18) Daily gain.

19) Yearling weight.

20) Size of pelvic arch.

21) Nursing index.

$$\text{Nursing Index} = \frac{\text{A.D.G. birth to weaning of all calves (same sex)}}{\text{A.D.G. of each calf in the group.}}$$

N.I. should be a good yardstick for selecting replacements.

Production or Enterprise Records

Cattle production is a business; it should no longer be just a way of life or a status symbol. Consequently, a producer must keep relevant records which should enable him to work out the efficiency of his business. These records should enable him to work out the following information concerning his business:

1) Gross output per acre.
2) Variable costs per acre.
3) Gross margin per acre.
4) Fixed costs per acre.
5) Maintenance and fixed costs per acre.
6) Fixed costs per $1,000 gross margin.
7) Net output per acre i.e. in gross output-feed+seed.
8) Maintenance and investment income per $1,000 capital.
9) Standard output per acre i.e. physical yield + closing valuation - opening valuation.
10) System index ie. $\frac{\text{Standard output x 100}}{\text{Standard output for comparable farms}}$
11) Labor costs per $1,000 net output.
12) Machinery costs per $1,000 net output.
13) Labor and machinery costs per $1,000 net output.
14) Labor efficiency index per $1,000 net output.

$$\text{Labor efficiency index} = \frac{\text{assessed labor requirement}}{\text{Actual labor supply}} \times 100$$

If there is any leak in production efficiency at anytime of the year, complete analysis of quarterly budget and end of year budget should pin point such a weakness. The producer can make use of these records to patch up weaknesses or to shift emphasis in production by constructing partial budgets where necessary.

VIII. ADULT EDUCATION IN RELATION TO CATTLEPROGRAM DEVELOPMENTS

After research scientists and government administrators have made their recommendations as to what is possible and economic to the farmers, it is duty of the extension service in cooperation with other interested agencies to educate farmers that they carry out the recommended practices. Research effort can be considered wasted if farmers do not adopt practices which are recommended. This gap can only be bridged by realistic adult education programs.

(1) The Livestock specialist as an educator

Self-preparation: The livestock specialist must be well prepared academically and pretty conversant with his line of interest. College education usually (though not always) determines the quality of one's leadership and achievements in adult education programs. Therefore the educator aught to have a University education and above all, an appetite for self-improvement; that is, inclination to cope up with new knowledge being poured out by research in his field. He should be able

to sort out those new findings, ideas or methods which could be applicable under certain circumstances. He should be aware of the fact that general education is cumulative.

Self-preparation is necessary to give a Uganda livestock Extension Educator confidence in himself. He should be so well acquainted with the subject matter and the methods of application that he can work out several alternatives to suit different groups of farmers or individuals in a group.

(2) Ability to Work with People: The extension educator should work with his farmers down to the grass roots. He should like them--even love some of them--visit their homes and share a cup of tea when it is offered. He should appreciate their hitherto achievements even though they may not be quite in the right direction. He should try to visit his farmers in working clothes (farm boots, T-shirt etc.) and not in a dinner suit. It is important to show them that he too can do and enjoy manual work as well as anybody in spite of his academic record and social standing--there is always a tendency of having "too many chiefs and not enough Indians" as regards farm manual work in relation to the so-called educated extension supervisors. He should be the first man to get his hands dirty on the farm.

After the educator has gained confidence of the people, he will be in a better position to find out the felt and unfelt needs of the people and what their motives are. Motives may be different between peasant farmers and progressive farmers; part-time farmers and full-time farmers. It is after he has ascertained his students' motives that he can safely get down to planning his program and devise the best means to get it underway.

(3) Objective: To a Uganda livestock extension educator, the objective of his program would be a stable and intensive mixed farming system based on a flexible but definite crop rotation. One realises that this is an objective which has to be achieved in stages. The educators role in this undertaking would be to influence the peasant farmer so that he gets started in the right direction. For those already started, his job is to encourage them and help them plan their next stages realistically and objectively.

(4) The Uganda Educator's Role: The educator should make the cattle farmers aware of the futility and wastefulness of the existing methods of cattle management. This would involve pointing out where their management becomes incompatible with high production and acceptable quality--factors which command price.

He should suggest alternative methods of production emphasizing ones he thinks would be best for an individual or group. However, he should let the farmers make their own decisions. He is a guide not a director.

After the discussion is made the educator should try to make them feel they are capable physically and financially of making it a success. This creates confidence within the farmers, or it should.

His next step should be helping the group organise a committee of their own choice, helping and advising on planning and informing them of, say, legal technicalities involved in the program. He should plan the program with them but let them make the decisions. He should give them all the relevant, up-to-date information regarding the industry; e.g., marketing situation, possible cost of inputs, short-time

versus long-time advantages, etc. It should be the job of the educator to arrange for any material he can get to assist the farmers with their program. This could be in the form of contacting interested parties to provide long-term, low interest loans, fencing wire, water troughs, construction of bore holes or dams or surfacing of the local muddy road. The role of the educator is not, and should not be, promising farmers wonders, but rather negotiating for certain services and materials considered necessary for the success of the program and getting these services and material on schedule and at the right place.

Once the program is underway the role of the educator is to keep the fire burning. He should encourage them all along, stay with them for better or for worse. He can arrange field trips to cattle research stations where farmers can actually see what they are aiming at or trying to achieve. Better still, field trips can be arranged to visit the farmers with similar resources and knowhow and who are engaged on the same program. Farmers like to compare notes and this would give them a competitive spirit and speed up the job.

IX. EDUCATION PROGRAM DEVELOPMENT FOR CATTLE PRODUCERS:

There are already two main systems of producing cattle in Uganda; cattle from large ranches, and cattle from small arable farms where the average herd for a family varies between 10 and 40 depending on population density and location.

Ranches are still few in number and are either cooperatives of very progressive business-minded farmers with means and pretty good knowhow, or Government-supported agencies. One feels however that emphasis should

be directed to the small arable farmer who desperately needs help to produce good animals for market. Proper programmingis necessary to bring this farmer into the economic picture.

(1) Philosophy of Our Education Program.

1) One should know that Extension Education programmingis concerned with adult education. Education is a process of changing the behavior pattern of people (farmers); that is, feeling, acting, attitudes, interests, thinking and appreciating responsibility; the end result of which is creation of better family life and better community life. Every eligible individual farmer should be considered in the program.

2) However education is being done it should embrace the cardinal principle of democracy: recognition of and respect for the individual's freedom to act and respond.

3) Education is a continuous process.

(2) Basic Principles Implied by the Philosophy:

1) In planning a beef cattle improvement program or any other educational program, one should realize that all people are not the same. If the livestock specialist or whoever is concerned just hands out a blanket program, the chances of success are small. The person in charge of program development should know that he is dealing with farmers of different abilities, different backgrounds, education levels, interest appreciations, and resources, and different age groups and experiences. Therefore the educator should adjust his teaching methods to suit his heterogenous community but keeping within the framework of his overall objective--better cattle production. For example, if a group of

exceptionally progressive farmers in the community want to use A.I. service, they should be given literature about A.I., or a trip should be arranged to an A.I. Center. Meanwhile one should use other teaching methods and techniques for those less successful farmers whose main trouble is general management of their pastures.

2) Uganda is a democratic country. Democracy should be seen to be a way of life even in establishing a beef cattle program. The educator should refrain from imposing his views on the farmers, instead should work along with them.

3) Since education is a continuous process, or ought to be, the educator should arrange the objectives, methods of teaching, and techniques in such a way that each learning experience re-enforces the previous one. This way the farmers will see the program as a whole rather than fragments of unrelated experiences which are likely to peter out soon.

(3) Methods and Procedures in Program Development

Analysis of Situation: In planning a beef cattle program, one should first collect relevant facts about the farmers. Then one should analyze this data, interpret it and identify problems which are likely to be met in getting the program through. This information would be valuable in deciding what teaching methods and to whom these methods should apply. This information is also valuable in enabling the educator to introduce his program in appropriate doses which can be assimilated adequately by those for whom it is intended. Such things as land tenure, average size of farm, average age of farmers and their education, type of soil, source of income, accessibility to cattle markets, availability of

all-year water supply, roads, and financial standing are all examples of the kind of information one needs in program development.

Program Balance: Beef cattle programs for Uganda producers at the present should be in balance with the existing agricultural, social and economic set up. An atmosphere of compatibility with human and material resources must be maintained. The success of cattle program is likely to be more successful on an arable farm (in the initial stages at least) when the cropping program is also in good shape.

(4) Long-Term Objectives: After a decision has been made that there should be a cattle improvement program in a locality, then long-term objectives should be spelled out as guide posts. Such guide posts should include:

1) Teaching farmers the knowhow of an economic mixed farming system.
2) Teaching farmers various production methods and enterprise so that they can diversify their income.
3) Getting farmers to specialize in their cattle production industry.

These objectives could be planned for a definite period; e.g., five years. This would fit in very well for the duration of each of Uganda's National Economic Plans.

Yearly Teaching Objectives: It is important that the long-term objectives be sorted out into annual objectives to facilitate implementation and re-enforcement of learning experiences. Annual objectives for a five-year plan could go like the following:

Year 1 Teaching farmers better practices in general livestock management. These practices would include for example:

(a) Housing of all classes of livestock
(b) Drinking water and salt
(c) Control of flies, worms, ticks, etc.
(d) Manure disposal
(e) Stall feeding or zero grazing high milk producers
(f) Culling and principles underlying the practice
(g) Interrelationship between nutrition, reproduction, growth and diseases
(h) Disease identification and control
(i) Management of herd bull
(j) Pasture management

Year 2 General management + fencing

Year 3 General management + fencing + selection and recording

Year 4 General management + fencing + selection and recording + management of exotic breeds

Year 5 Continuation of all practices in 4th year + formulation of concentrate rations and use of A.I. service.

These yearly objectives or practices should be flexible so that adjustments can be made from time to time, as the situation requires.

CONCLUSION

Some major problems of the agricultural industry at large and cattle production in particular.

There exist in Uganda some institutional impediments to general agricultural and livestock production progress. These institutions tend to inhibit the play of individual incentives to work hard, to save, to invest, to innovate, to take risks or to acquire skills.

Land tenure institutions are perhaps the major problem to a would-be progressive farmer. In most areas suitable for mixed farming, land fragmentation through inheritance and "custom law" has gone so far as to become the main limiting factor to efficient cattle production.

The pricing and marketing systems, or lack thereof, also tend to destroy the play of incentives for the farmer to work, to invest, or to innovate. Prices for identical products tends to vary widely between areas at random, and there is usually no adequate way of predicting price fluctuations between places and between seasons. The problem is usually not so much of prices being too low or of marketing margins being too high; but primarily that of the farmer's uncertainty as to what the price will be and who will get the higher price--himself or the cattle trader.

The type of social organization--the greater family or tribe or the so-called "African extended family system" profoundly affects the play of incentive. Under this system the more economic rewards a farmer gets out of his labors, the more he is expected to give away to his so-called less fortunate "relatives"! This system is incompatible with the "shrewd and mean" business attitude so desirable for self-improvement in the business world.

Year 1 Teaching farmers better practices in general livestock management. These practices would include for example:

(a) Housing of all classes of livestock
(b) Drinking water and salt
(c) Control of flies, worms, ticks, etc.
(d) Manure disposal
(e) Stall feeding or zero grazing high milk producers
(f) Culling and principles underlying the practice
(g) Interrelationship between nutrition, reproduction, growth and diseases
(h) Disease identification and control
(i) Management of herd bull
(j) Pasture management

Year 2 General management + fencing

Year 3 General management + fencing + selection and recording

Year 4 General management + fencing + selection and recording + management of exotic breeds

Year 5 Continuation of all practices in 4th year + formulation of concentrate rations and use of A.I. service.

These yearly objectives or practices should be flexible so that adjustments can be made from time to time, as the situation requires.

Another major deterrent to efficient cattle production in Uganda up to now has been the lack of adequate processing facilities. Lack of proper transportation often requires the movement of animals on foot over long distances to market. Lack of refrigeration facilities makes it necessary to utilise meat quickly near the point of slaughter. Some planning and action has to be done, and be done fast, for a prosperous cattle industry can hardly be expected to develop in a situation where the essential links--production, marketing and processing facilities--between the producer and the consumer are too weak to meet the needs of either party.

Lack of technical and scientific leadership is also an impeding problem to Uganda agriculture and cattle production. Since our independence in 1962, most of the scientists (largely British) have tended to leave the country at a rather uncomfortable rate. Although Uganda is doing her mighty best to replace them with Ugandans, one must admit that it takes at least five to seven years for a newly installed Masters or PhD. to gain experience and competence in his field as a researcher, particularly if he is trained in a temperate zone and has to start from scratch. It can be done in two to three years, however.

Last but not least, we need a review of our education program in the field of agriculture and livestock. More and better trained field staff are desperately required and should be given a large dose of extension education (Uganda-conditions orientated) before being put into the field--and a periodic dose thereafter.

All told, it is important that those of us involved in and/or committed to the establishment of an efficient agricultural and cattle

production be able to recognize the Nation's farming problems without bias, and endeavor to solve them as they emerge to the best of our ability; and do so, as far as possible, within a truly democratic framework.

ACKNOWLEDGEMENT

The author wishes to express his deep appreciation and gratitude to Dr. Don Good, Head of Animal Husbandry Department, Dr. B. Brent, Animal Nutrition Section, and Mr. D. Z. McCormick, International Agricultural Programs, A.I.D. Office, Kansas State University for invaluable help and guidance they gave in developing this report.

Also thanks are extended to Mrs. L. Semm and Dr. N. E. Masaba for information and help they provided the author.

REFERENCES

Black, W. H., A. T. Semple, J. L. Lush 1934. Beef Production and Quality as Influenced by Crossing Brahman with Hereford and Shorthorn Cattle. U.S.D.A. Tech. Bull. 417.

Blaser, R. E., R. C. Hammes, H. T. Bryant, C. M. Kincaid, W. H. Skrdla, T. H. Taylor and W. L. Griffetch 1956. The Value of Forage Species and Mixtures for Fattening Steers. Agron. J. 48:508.

Bonsma, F. N. 1951. Africa South of the Sahara. Ed. by Anne Welsh, London. Oxford University Press.

Briggs, H. M. 1951. Modern Breeds of Livestock. New York. MacMillan Company.

Buckley, L. 1953. Mpwapwa Report. Tanganyika Department of Vet. Science. Tanganyika.

Cartwright, T. C. 1955. Beef Cattle Response to Ambient Temperatures. J. An. Sci. 3:350.

Curson, H. H., R. W. Thorton 1936. A Contribution to the Study of Native African Cattle. Ibid 7:613.

Diggins, R. V., C. E. Bundy 1956. Beef Production. Englewood Cliffs, New Jersey. Prentice-Hall, Inc.

Ellis, B. S. 1953. The Soil and Farming Systems in South Rhodesia with Special Reference to Grass Leys. Rhodesian Afric. J. 50:379.

Hammond, J., J. C. Bonsma 1955. Degeneration of European Breeds of Beef Cattle in the Tropics. Breeding Beef Cattle for Unfavorable Environments. Austin, Texas. Ed. by Rhoad.

Hancock, J., W. Payne 1955. Heat Tolerance in Cattle. Emp. J. Expt. Agric. 23:55.

Harker, K. W., J. I. Tylor, D. H. L. Hollinson 1954. Studies on the Habits of Zebu Cattle. I Preliminary Observations on Grazing Habits. J. Agric. Sci. 44:193.

Hart, E. B., E. V. McCollum, H. Steenbock and E. C. Humphrey. 1911. Physiological Effect on Growth and Reproduction on Rations Balanced from Restricted Sources. Wisconsin Agri. Expt. Sta. Bull. 17; 131.

Herman, H. A. 1956. Age-Fertility Relationships in Cattle Serviced by A.I. 3rd Intern. Congr. Animal Reproduction. Cambridge.

Horrel, C. R., M. N. Court, 1965. Effects of the Legume Stylosanthes gracilis on Pasture Yields at Severe. J. Brit. Grassl. Soc. 20:72.

REFERENCES--Continued

Joblin, A.D.H. 1960. The Influence of Night Grazing on the Growth Rates of Zebu Cattle in East Africa. J. Brit. Grassl. Soc. 15:212.

__________. 1963. The Use of the Grazing Animal Observations in the Early Stages of Pasture Evaluation in the Tropics. J. Brit. Grassl. Soc. 17:171.

Joshi, N. R. 1957. Types and Breeds of African Cattle F.A.O. Agriculture Studies No. 37.

Knapp, B. Jr., R. T. Clark. 1950. Revised Estimates of Heritability of Economic Characteristics in Beef Cattle. J. An. Sci. 9:582.

Lee, D.H.K. 1955. Heat Tolerance in Cattle. Breeding Beef Cattle for Unfavorable Environments. Austin, Texas. Ed. by Rhoad.

Lush, J. L. 1945. Animal Breeding Plans, Ames, Iowa Collegiate Press.

McCall, L. 1926. Tanganyika Vet. Department Annual Report. Tanganyika.

Morrison, R. A., and R. E. Erb. 1957. Factors Influencing Prolificacy of Cattle. I Reproductive Capacity and Sterility Rates. Washington Agri. Expt. Sta. Tech. Bull. 25.

Phillips, R. W. 1962. The Livestock Industry--Its Scope and Potential. Introduction to Livestock Production. Ed. by H. H. Cole, W. H. Freeman and Company, San Francisco.

Rhoad, A. O. 1944. The Iberia Heat Tolerance Test. J. Trop. Agric. 21:162.

Rice, V. A., F. N. Andrews, E. J. Warwick and J. E. Legates. 1957. Breeding and Improvement of Farm Animals, New York. McGraw-Hill Book Company.

Salisbury, C. W., N. L. Van Demark. 1961. Physiology of Reproduction and Artificial Insemination of Cattle. University of Illinois, W. H. Freeman & Company.

Scruggs, C. G. 1965. Selecting Cattle for Efficient Production. The Progressive Farmer Company. Library of Congress Catalog Card No. 65-15385.

Snapp, R. R., A. L. Neumann. 1965. Beef Cattle. 5th Ed. John Wiley & Sons, Inc.

Stobbs, T. H. 1965. Animal Production from Pasture Leys. Annual Report 1964-65. Serere Agricultural Research Station (Uganda).

REFERENCES--Continued

Stobbs, T. H., A.D.H. Joblin. 1966. The Use of Liveweight-gain Trials for Pasture Evaluation in the Tropics. J. Brit. Grassl. Soc. 21:181.

Tanabe, T. Y., G. W. Salisbury. 1946. Influence of Age on Breeding Efficiency. J. Dairy Sci. 29:337.

Theiler, A., H. H. Green. 1931. Aphosphorosis in Ruminants. Nutr. Abstr. and Rev. 1:359.

Theiler, A., H. H. Green and P. J. Du Toit, 1928. Studies in Mineral Metabolism. III Breeding of Cattle on Phosphorus Deficient Pasture. J. Agric. Sci. 18:369.

Thomas, P. T. 1962. Guide to Farm Grasses. Welsh Plant Breeding Station, Aberystwyth. Great Britain.

Uganda, Protectorate 1953. Department of Vet. Science, Entebbe (Uganda).

Uganda Protectorate 1955. Department of Agri. Annual Report. Entebbe (Uganda).

Uganda Report 1965. Min. of Information, Broadcasting and Tourism (Uganda).

Uganda Vet. Science Annual Report 1966. Min. of Animal Industries and Fisheries.

Williams, E., V. A. Bunge 1952. Development of the Zebu Herd of Bukedi Cattle at Serere, Uganda. Emp. J. Expt. Agri. 20:142.

Winters, L. M. 1948. Animal Breeding. New York. John Wiley and Sons.

ROLE OF SCIENCE IN EFFICIENT BEEF CATTLE PRODUCTION AND PROGRAMING PROCEDURE AND PRACTICES FOR PRODUCERS IN UGANDA

by

EMMANUEL FRANCIS BAJUNIRWE

B. Sc. (Dunelm), Durham University, Great Britain 1964

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

Today there is an urgent need for Uganda to improve her beef cattle production practices not only to meet both her domestic and export demands, but also to contribute more appreciably to the betterment of the nation's general overall agriculture.

The objective of this report is to show what role scientific principles, concepts, and practices can, and should, play in an effort to meet this need within the framework of Uganda's natural and human resources and limitations.

Although astride across the equator, Uganda's high altitude and savannah plateau make it climatically and ecologically suitable for cattle production. There are two pronounced dry seasons in a year during which time cattle production is adversely affected, but this problem can be overcome by adopting better methods of pasture management and conservation of feed.

The need for an efficient and economic beef cattle program in Uganda has been described. And also pointed out are the advantages of such a program as an integral part of Uganda's agriculture.

So far the results of our intensive scientific investigation of the pasture's productive potential and utilization by the local cattle breeds, tend to indicate that under good pasture management there is a need for superior stock to justify the effort and expense of establishing and maintaining such pastures. Under the best possible pasture and animal husbandry management none of the three local breeds appears capable of much more than 0.6 lb. average daily liveweight gain.

Distribution and characteristics of each of the three main local breeds of cattle have been described. Their advantages and disadvantages on high level of management under Uganda conditions have also been pointed out. In spite of their relatively low inherent productive capacity the local breeds are still useful because they are fully adapted to Uganda conditions unlike their more productive European counterparts. For this reason large importation of European breeds as replacement should be done with caution, bearing in mind the fact that they are not adapted to Uganda's tropical environment.

In search of more productive stock capable of economic response to improved management, attention has been turned to European breeds and the Boran. It is hoped that through application of breeding techniques between the local breeds and the European breeds a new breed will evolve which will combine and express the best of Bos taurus and Bos indicus under Uganda conditions.

The advantages of A.I. in regard to beef cattle improvement program were pointed out. It is noteworthy, however, that a high standard of management is a pre-requisite to the success of A.I. practice. With more attention to herd improvement and management, better breeding through selection and use of A.I., development of improved pastures and better feed conservation techniques, it should be possible to bring about a substantial expansion in beef cattle industry in Uganda in terms of both quality and quantity.

For scientific information and recommendations to mean anything at all, they must be passed on to the farmers in such a manner that they areaccepted and adopted. There should be a well-planned and properly executed extension education program to effect this adoption. This great undertaking is largely the responsibility of the extension specialist who should pull together all resources available to him in an effort to get farmers accept and practise the new techniques in cattle production.

It should be realized that it is largely through foresight, and above all, a sober co-operative effort by all relevant agencies -- the researchers, extension staff, vocational agriculture educators, businessmen, and the government -- that Uganda can identify and resolutely dedicate her resources to solving prevailing problems in beef cattle industry through the medium of science.